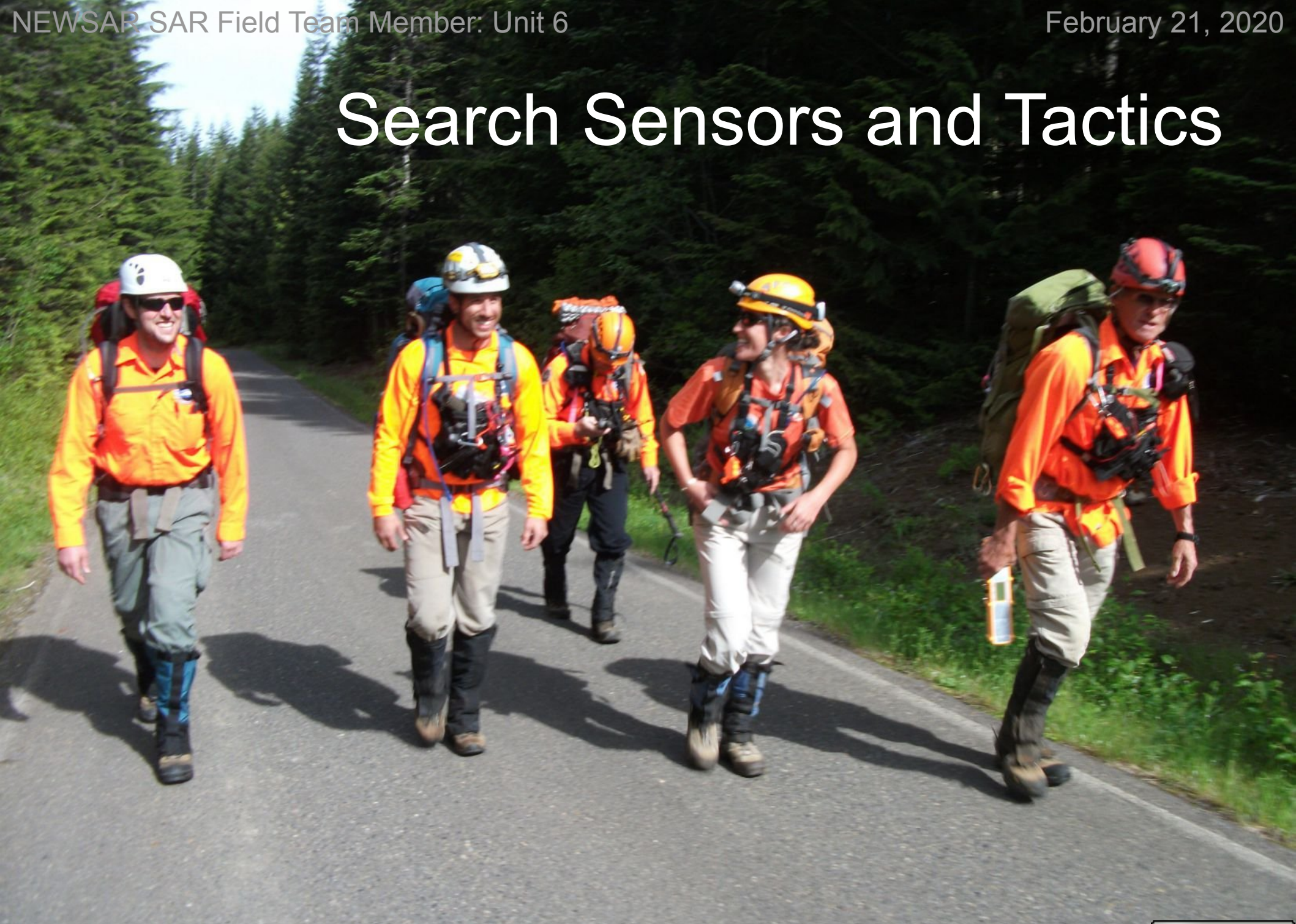


# Search Sensors and Tactics



# Search Crucials

- Search is an Emergency
- Search is a classic mystery
- **Search for clues not just the subject**
- Know if the subject leaves the search area
- **Close grid search as a last resort**
- Manage by objectives
- Search management is information management



# Subject Finders and Clue Finders













# Ground Search Resources

- Clue Aware Searchers
  - Volunteer SAR organizations
  - Civil Air Patrol
  - SAR trained Police, Fire, CERT personnel
  - Signcutters
  - Search Dogs
  - Horses
- Subject Finders
  - Firefighters (without SAR training)
  - Technical rescue resources (without SAR training)
  - CERT teams (without SAR training)
  - Spontaneous volunteers

# External Influences



# Other Resources

- Search Managers
- Communications
- Hazardous Materials Response (Fire Service)
- Information Resources
- Sensors
  - Thermal Imaging
  - FLIR
  - Light Amplification
- Air resources
  - Helicopters, Drones, Aircraft





# Fire Service Resources

- Wildland firefighters (local terrain knowledge)
- People to go door to door with flyers, resources for Containment
- Lights (scene lighting, attraction)
- Rehabilitation (mist fans)
- Communications
- Thermal imagers
- Technical rescue (high angle, confined space, water (wetsuits, drysuits))



- Helicopters/Aircraft/Drones
- Mountain Bike teams
- ATV/Snowmobile





# Canines

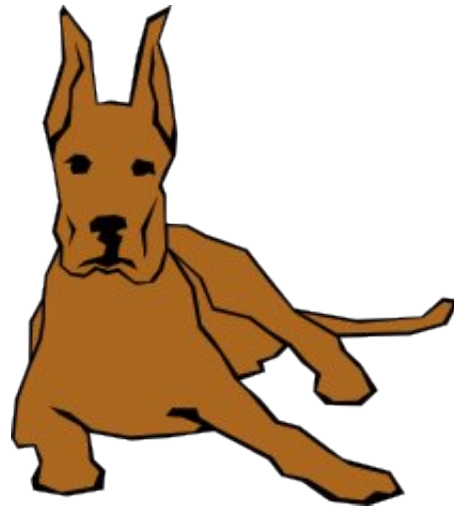
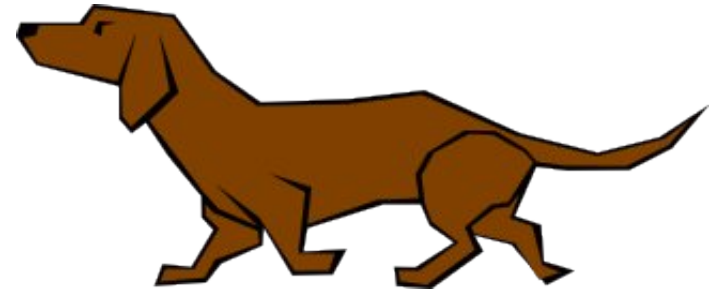
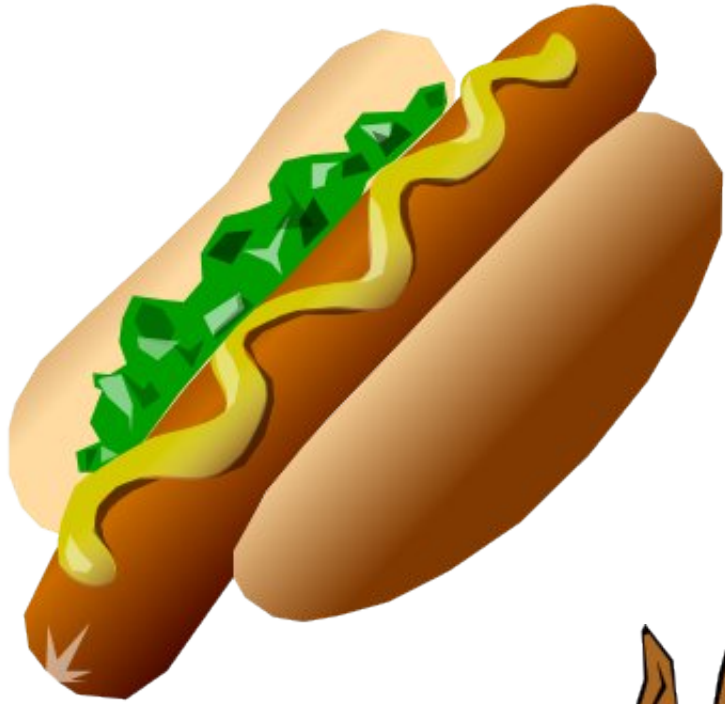




# Typed Resources

- Call out the dogs....







# FEMA Typed Canine SAR Resources

- Canine Search and Rescue Team – Avalanche Snow Air Scent
  - Type I, Type II
- Canine Search and Rescue Team – Disaster Response
  - Type I, Type II, Type III, Type IV
- Canine Search and Rescue Team – Land Cadaver Air Scent
  - Type I, Type II, Type III, Type IV
- Canine Search and Rescue Team – Water Air Scent
  - Type I, Type II, Type III, Type IV
- Canine Search and Rescue Team – Wilderness Air Scent
  - Type I, Type II, Type III, Type IV
- Canine Search and Rescue Team – Wilderness Tracking/Trailing
  - Type I, Type II, Type III, Type IV



# Canines

- Wilderness Air Scent
- Trailing
- Tracking
- HRD
- Water
- Avalanche
- Disaster
  - Live Find
  - HRD



# Tracking and Trailing









# Wilderness Air Scent





# Wilderness Air Scent



**Route Search**

A topographic map of the Pepperell area in Massachusetts. A yellow line highlights a path starting from North Pepperell, following the river valley southwards. The map shows contour lines, roads, and various landmarks like 'Pork Barrel' and 'Hovey Corner'. The text 'Route Search' is overlaid in large black font on the left side of the map.

**Area Search**

A topographic map of the Pepperell area in Massachusetts. A yellow rectangle highlights a specific area in the center of the map, near the 'Four Corners' junction. The map shows contour lines, roads, and various landmarks like 'Pork Barrel' and 'Hovey Corner'. The text 'Area Search' is overlaid in large black font on the right side of the map.



# Sign Cutters





# Determining Direction of Travel

- Signcutters
  - Tracking from IPP
  - Binary Search
  - Track Traps
- Tracking Dogs
- Trailing Dogs
- Clues



# Tactics

- Direct (=Active)
  - Go and find the subject.
- Indirect (=Passive)
  - Make the subject come to you.

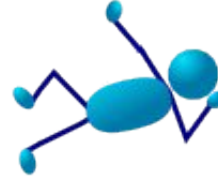
Responsive

Unresponsive

Mobile



Immobile





# Unresponsive

## Mobile



Dementia < 4 hours



## Immobile



Dementia > 4 hours

# Responsive



Hunter < 8 to 24 hours  
Hiker < 6 to 14 hours



Hunter, Hiker > 24-72 hours



# Responsive? Sound Sweep

- Stop
- Pause
- Call Subject's name
- Wait and **listen** (important part)
- Continue



# Tactics

- Direct/Active

  - Go find the subject.




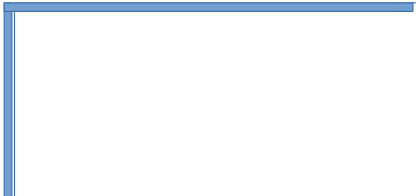
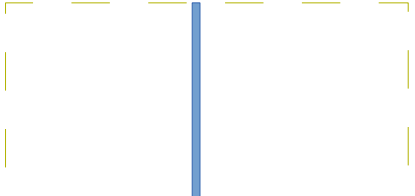
  - **Type I to Type IV search (human, canine, equine)**
  - Aerial search

- Indirect/(Passive)

  - Make the subject come to you.

  - Investigation
  - Containment
  - Attraction
    - Sound
    - Lights
  - “Limited Continuing Search”

# Search Geometries

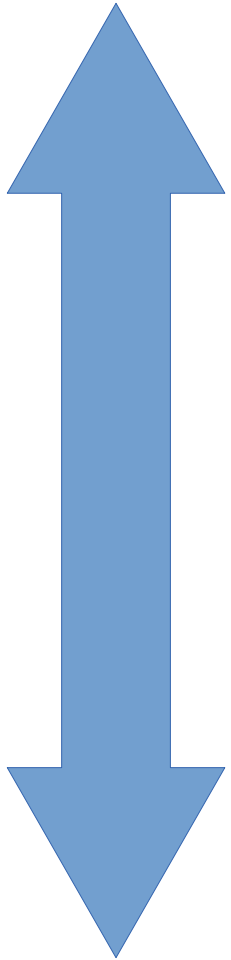
- Route Search 
- Area Search
  - Segment 
  - Corridor 
- Boundary Search
  - Containment 
  - Binary Search 



# Types of Ground Search

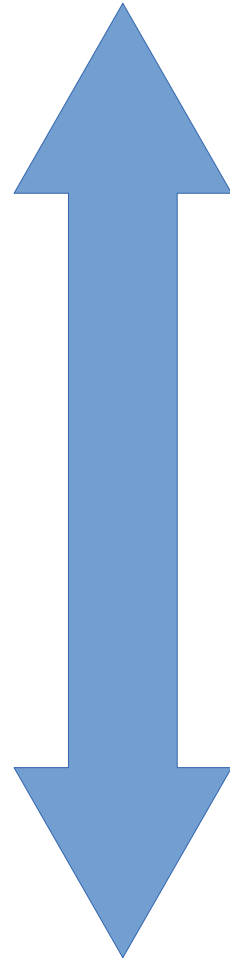
- **Type I**
  - Hasty tasks: speed – trails, high probability and high risk areas.
- **Type II**
  - Small teams, loose grid - efficiency
  - Clue finders with critical separation
- **Type III**
  - Grid search – Thorough, slow, **destructive**
- **Type IV**
  - Evidence Search

Hasty



Evidence

Efficient  
Minimally Destructive



Thorough  
Destructive



Type I - Hasty

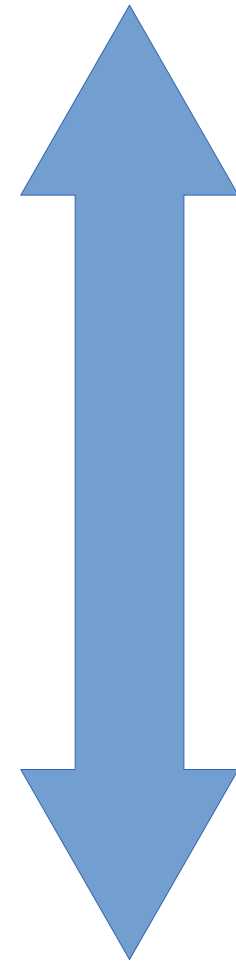
Efficient

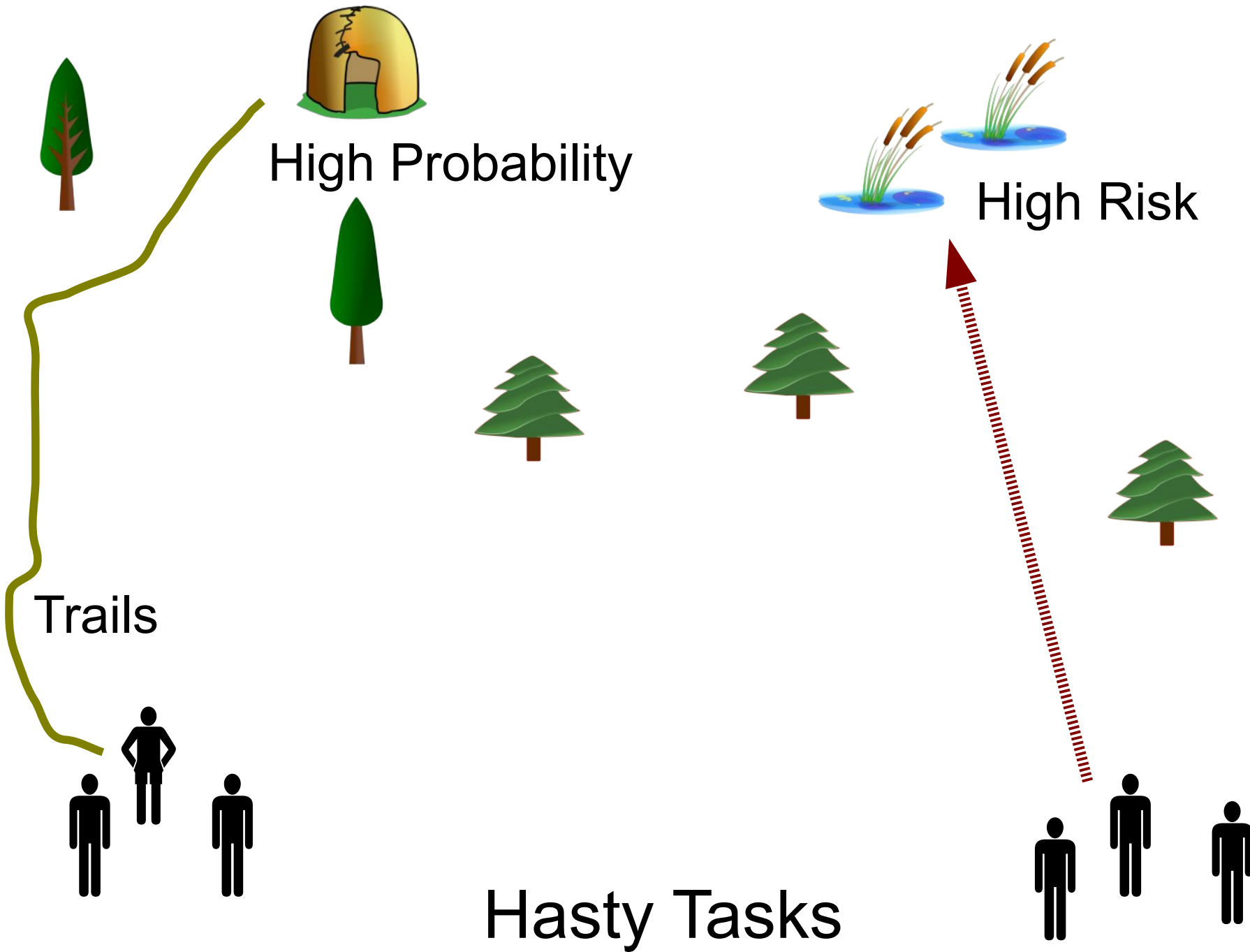
Type II – Purposeful  
Wandering

Type III - Grid

Type IV - Evidence

Thorough  
Destructive

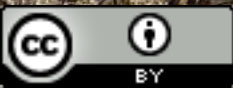






Special attention should be paid to enclosures like refrigerators, freezers, and the interior of parked vehicles where limited breathing air may place the child at even greater risk.





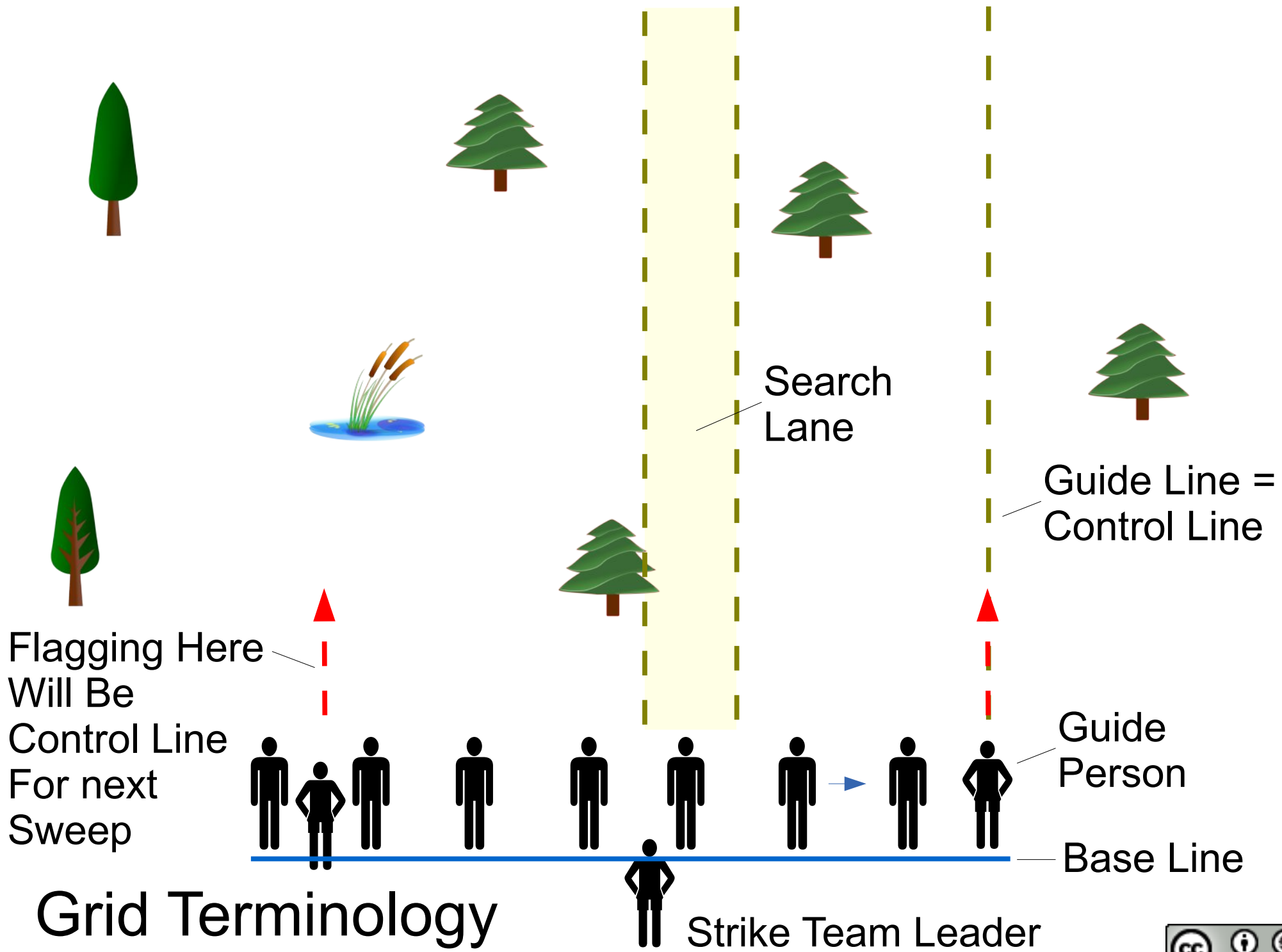


# Type II search



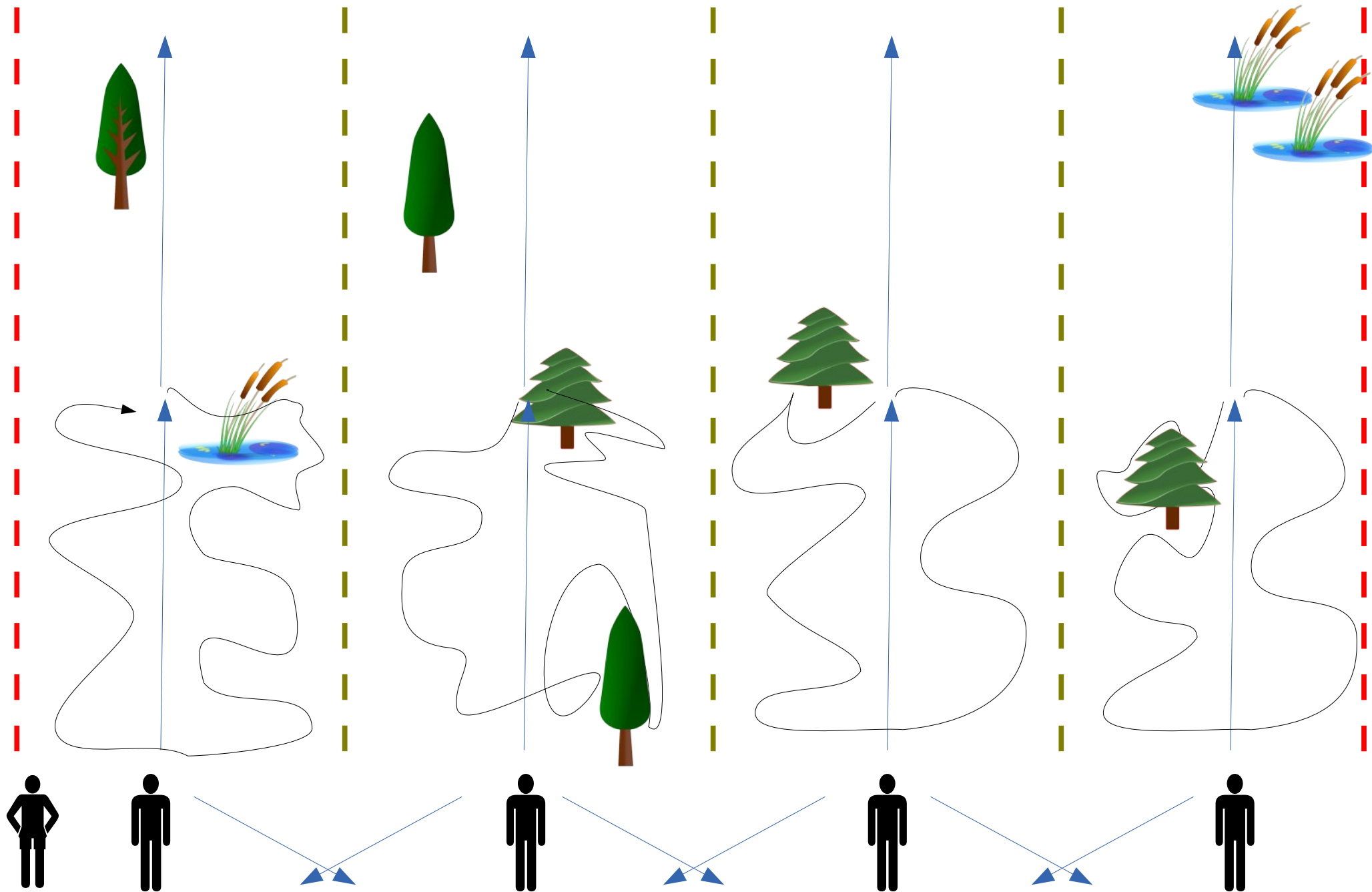
• Emphasis: Efficiency

Type II Grid



# Grid Terminology



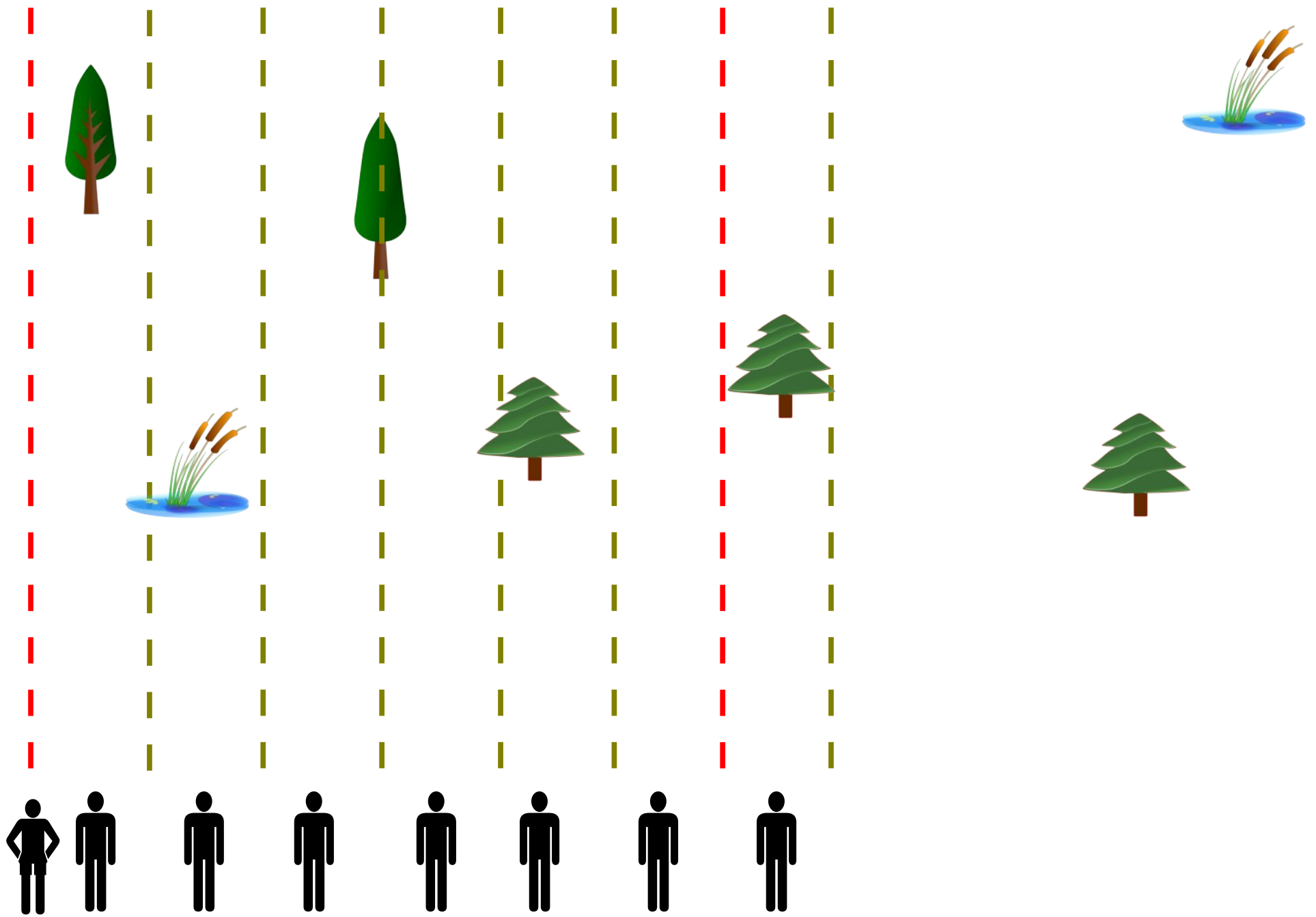


Critical separation & purposeful wandering

# Search Crucials

- Search is an Emergency
- Search is a classic mystery
- Search for clues not just the subject
- Know if the subject leaves the search area
- **Grid search as a last resort**
- Manage by objectives
- Search management is information management





Type III (Line Search / Grid Search)

# Type II Grid

Trained  
Clue Aware  
Searchers  
or  
Air Scent  
Canine

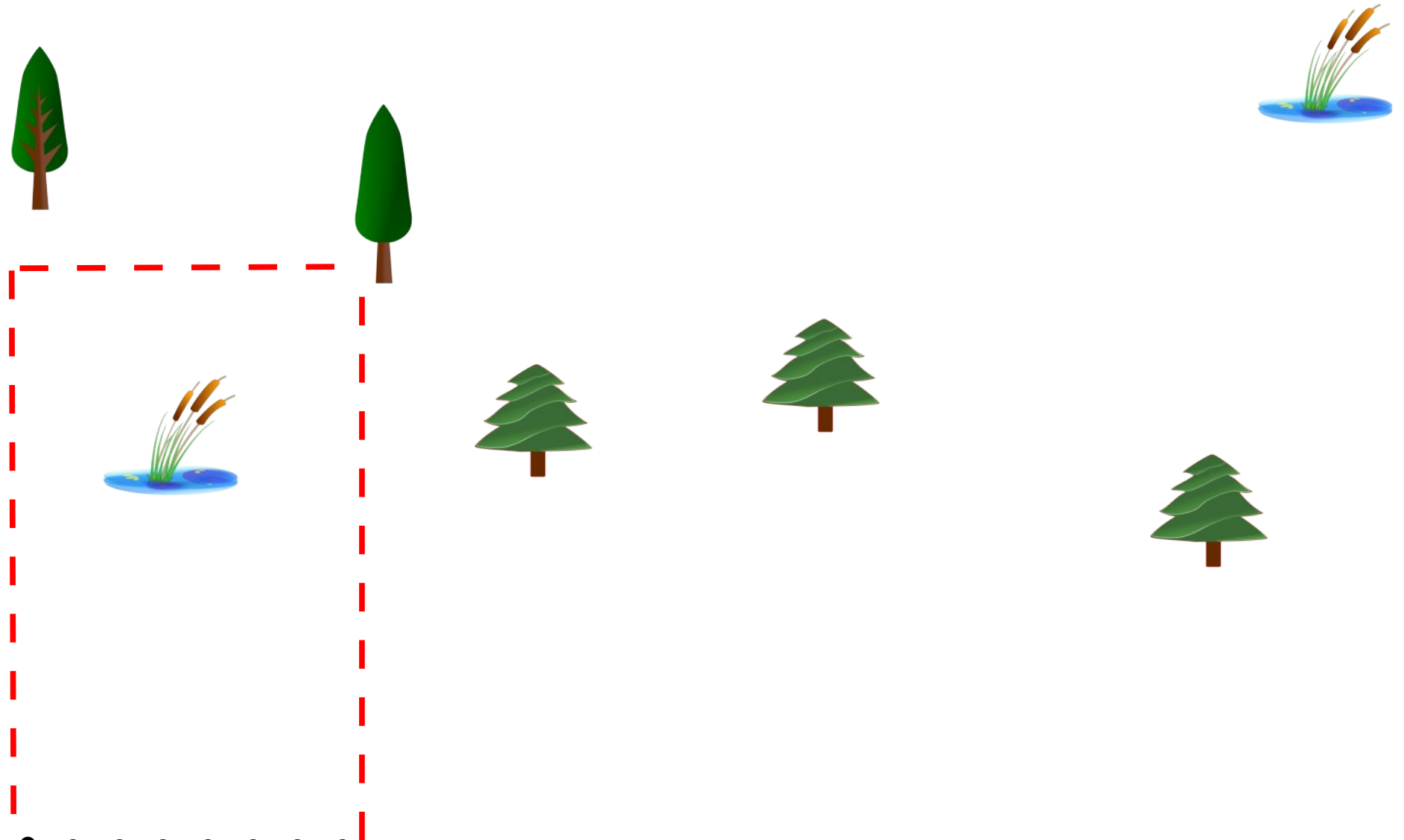
Purposeful  
Wandering  
Within  
Search  
Lane

Searcher  
Stays in  
Center Of  
Search  
Lane

Trained or  
Untrained  
Searchers

# Type III Grid





# Type IV Evidence Search





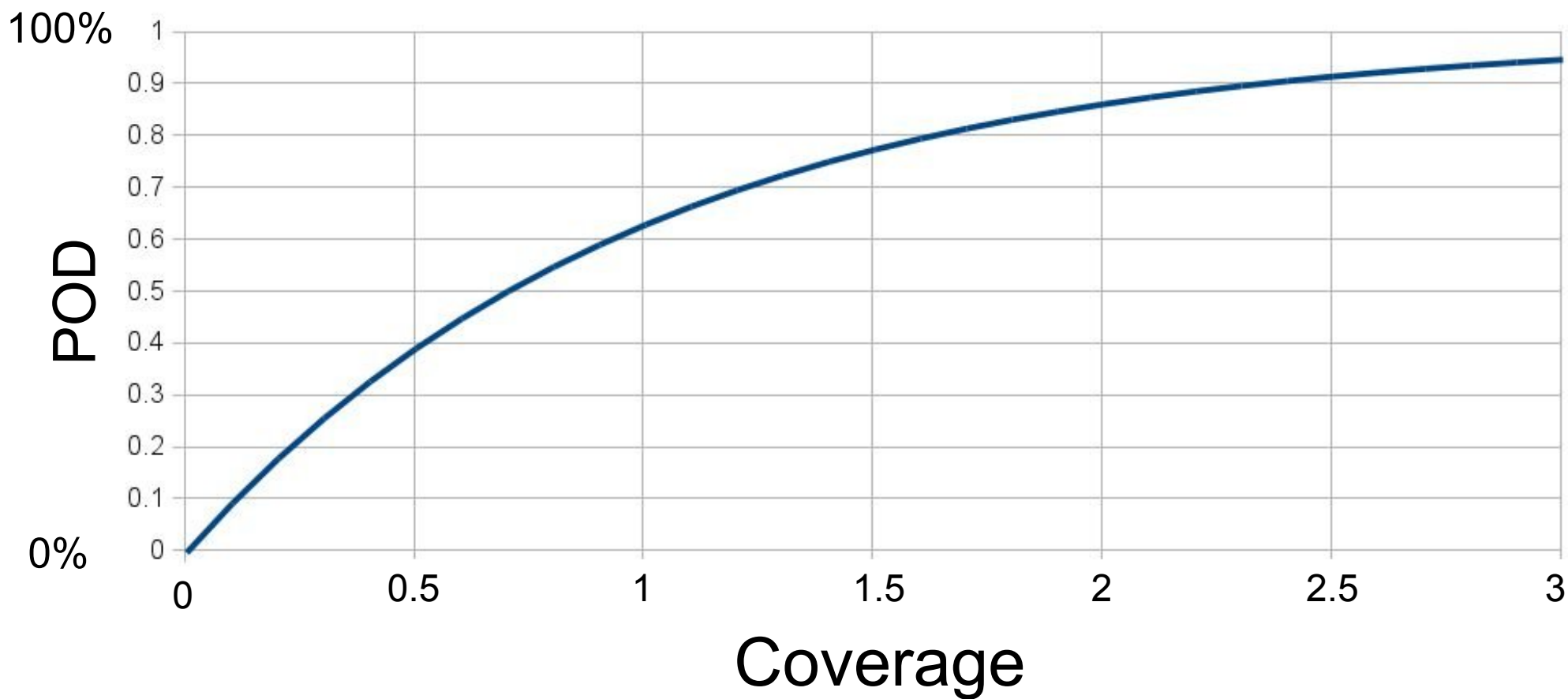
# Factors affecting POD for ground search

- Sweep Width
- Area Size/Time
- Tactics
- Terrain
- Vegetation
- Light
- Weather
- Hazards
- Team Composition/Fatigue



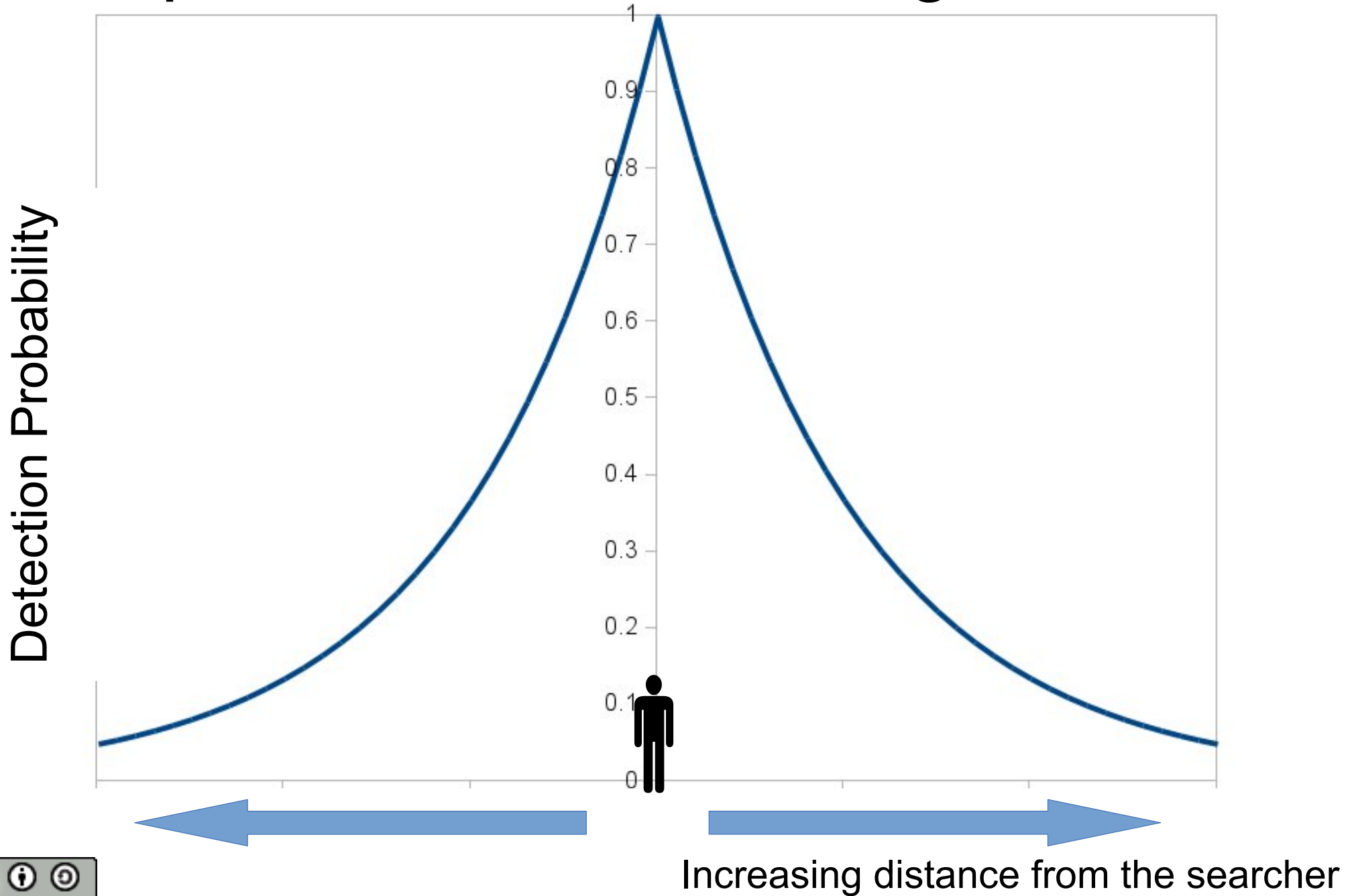
How well was  
the area covered?

# The Exponential Detection Function

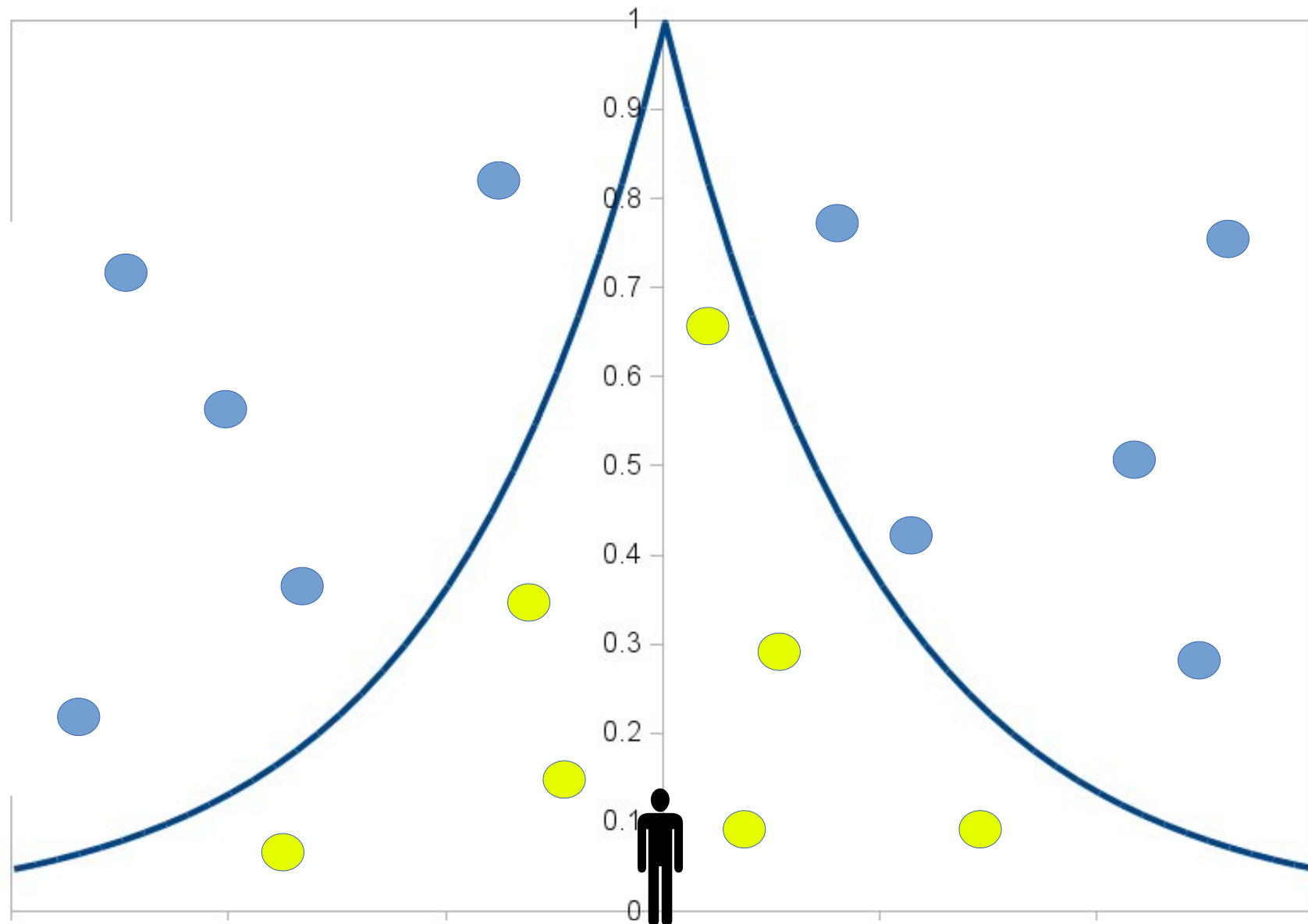




# Exponential Lateral Range Curve



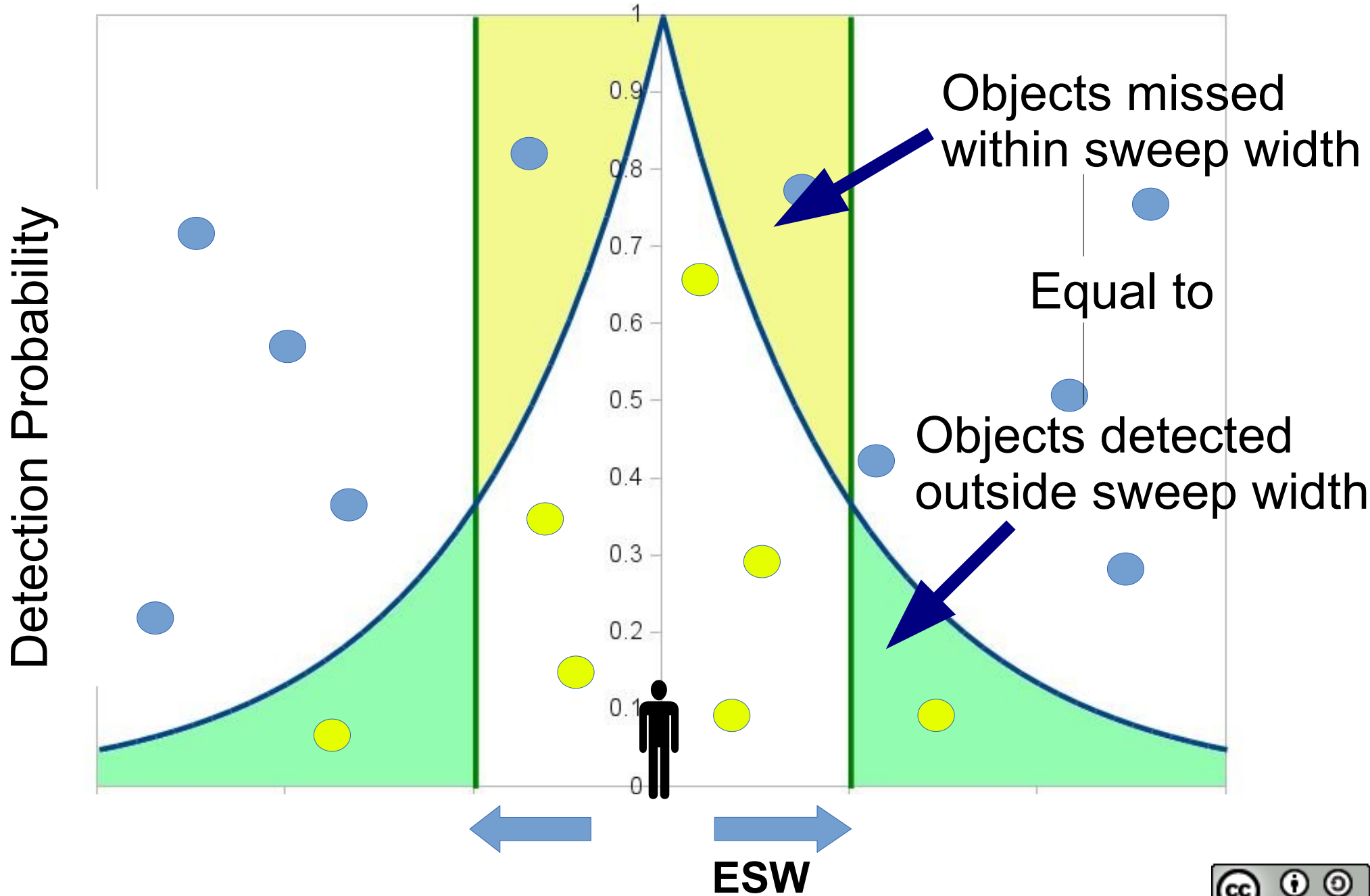
Detection Probability



Increasing distance from the searcher

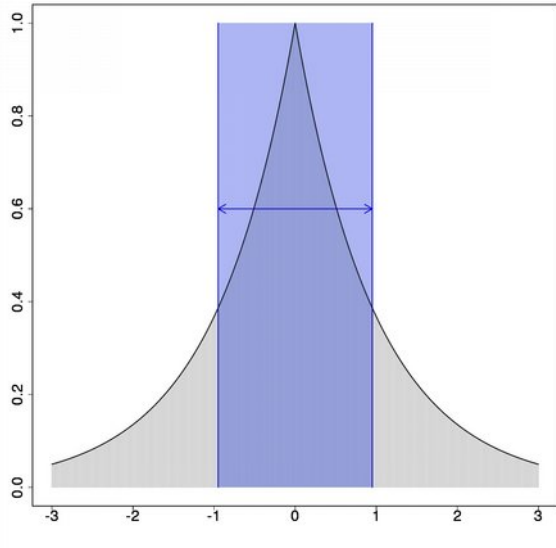


# Effective Sweep Width

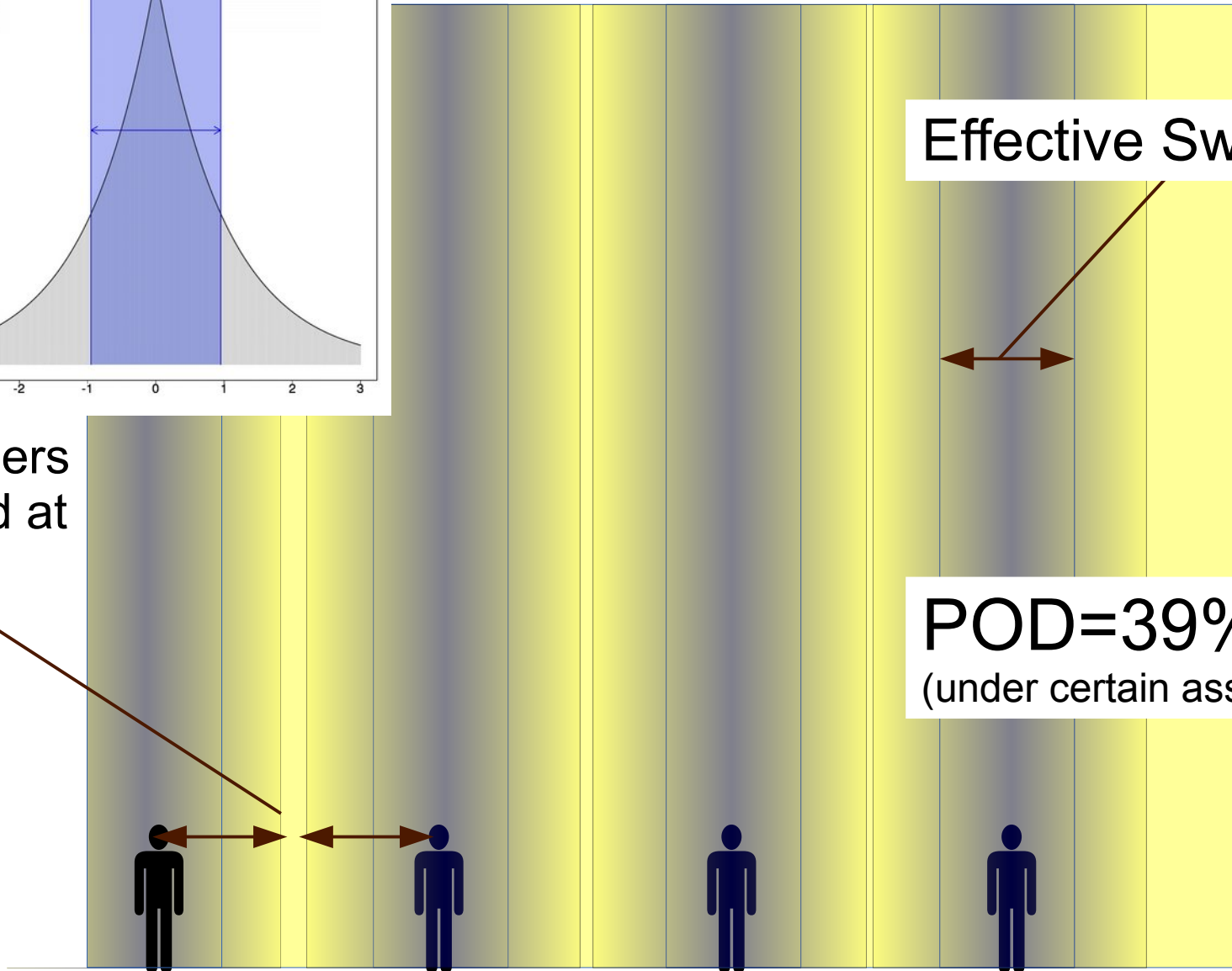


# Searchers spaced at 2 Effective Sweep Widths

## Coverage of 1/2



Searchers  
Spaced at  
2 ESW

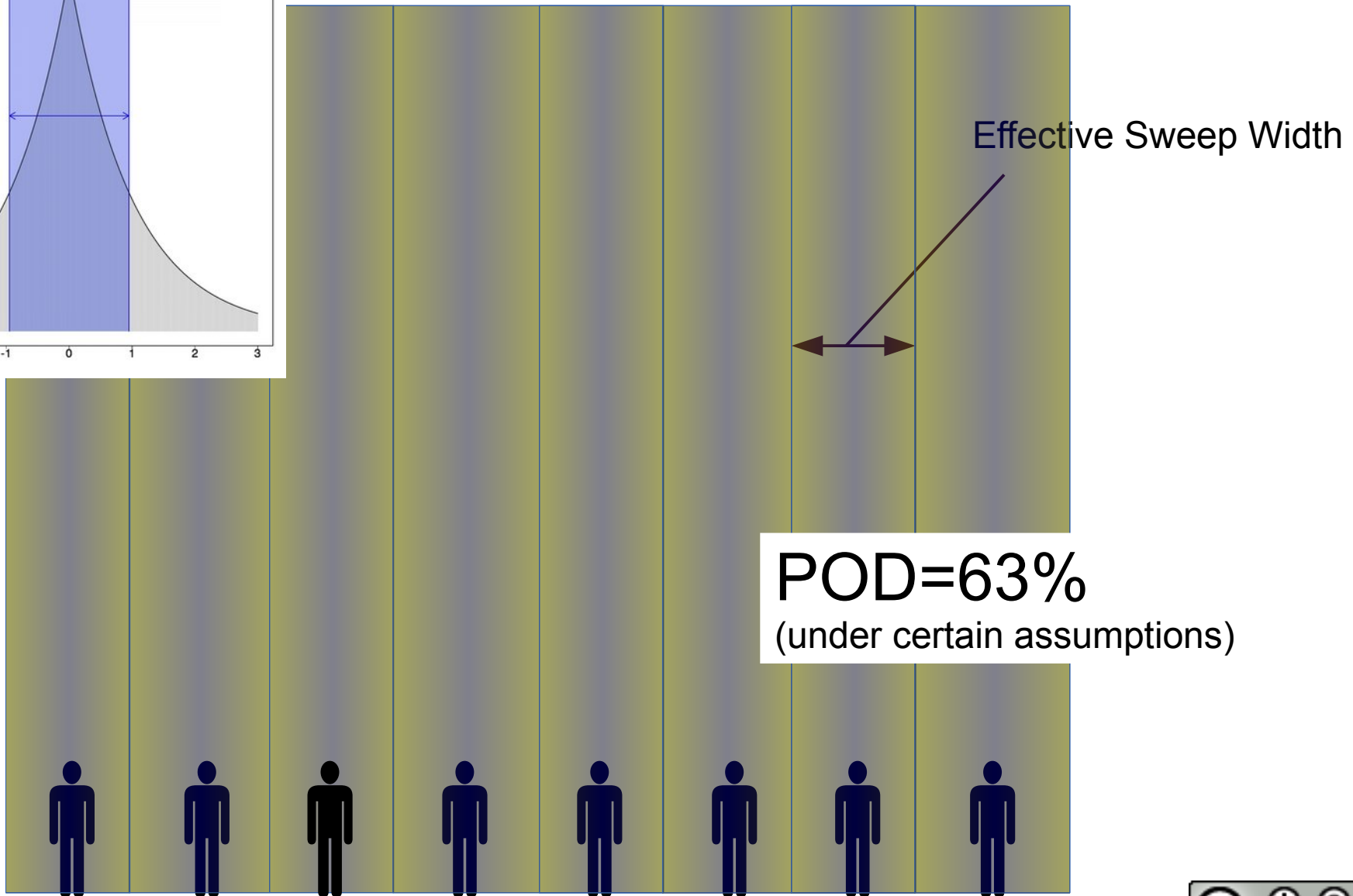
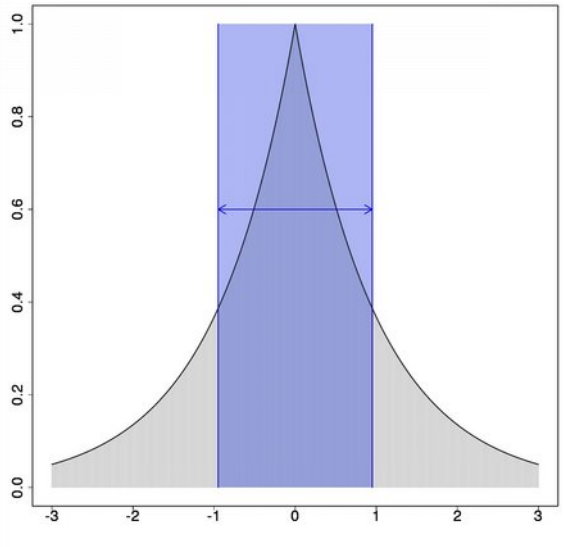


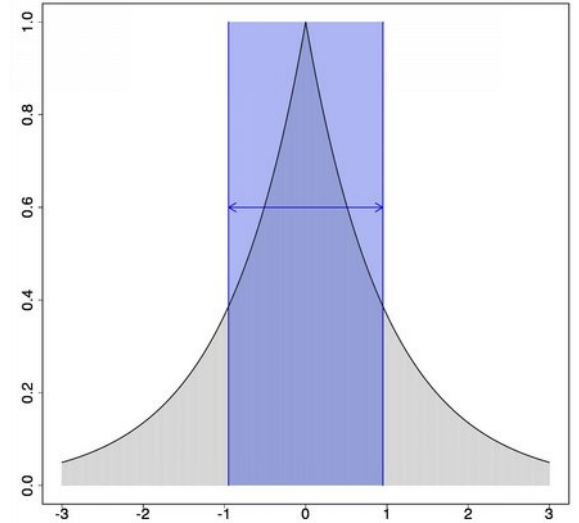
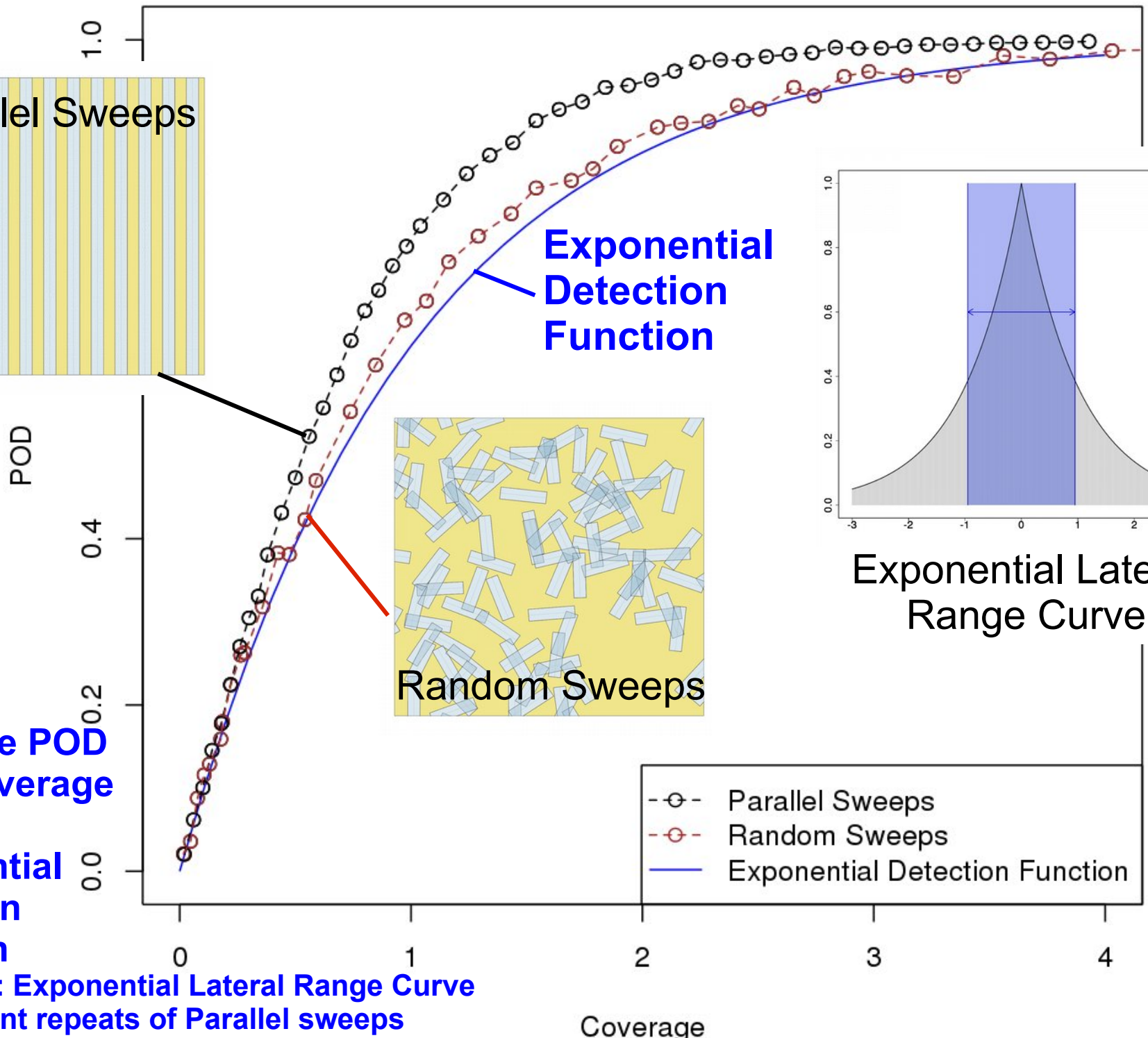
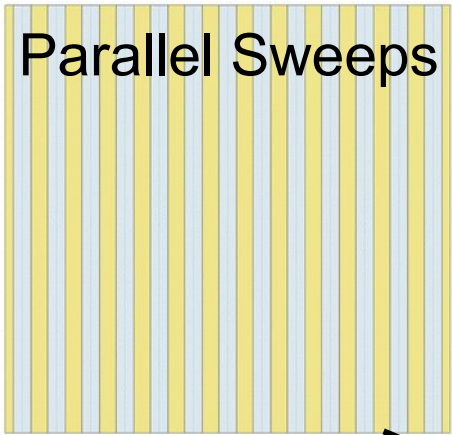
Effective Sweep Width

POD=39%  
(under certain assumptions)



# Searchers spaced at 1 Effective Sweep Width Coverage of 1





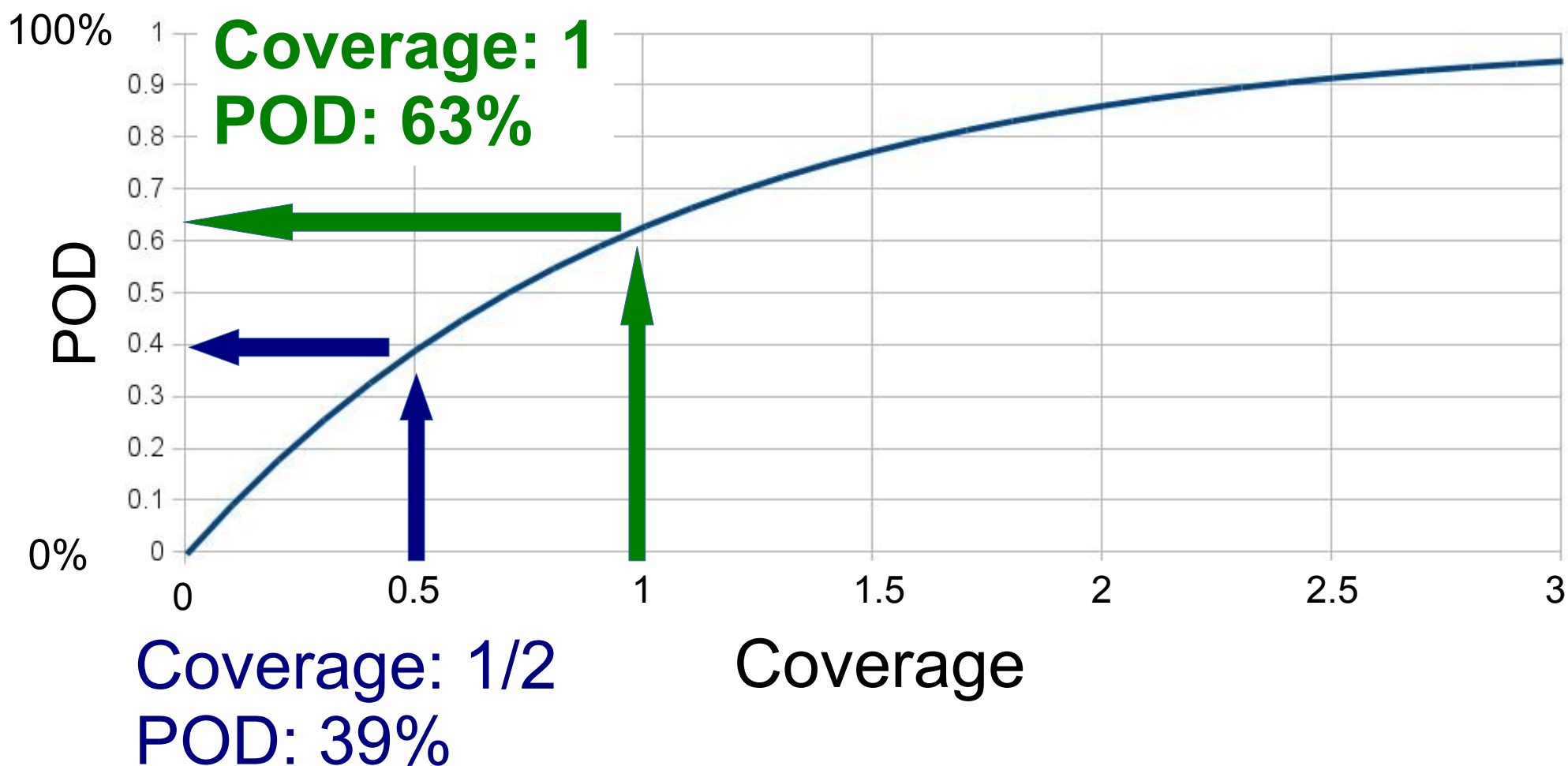
**Calculate POD from Coverage with the Exponential Detection Function**

**Assuming: Exponential Lateral Range Curve  
Independent repeats of Parallel sweeps  
Parallel sweeps have some navigation errors**

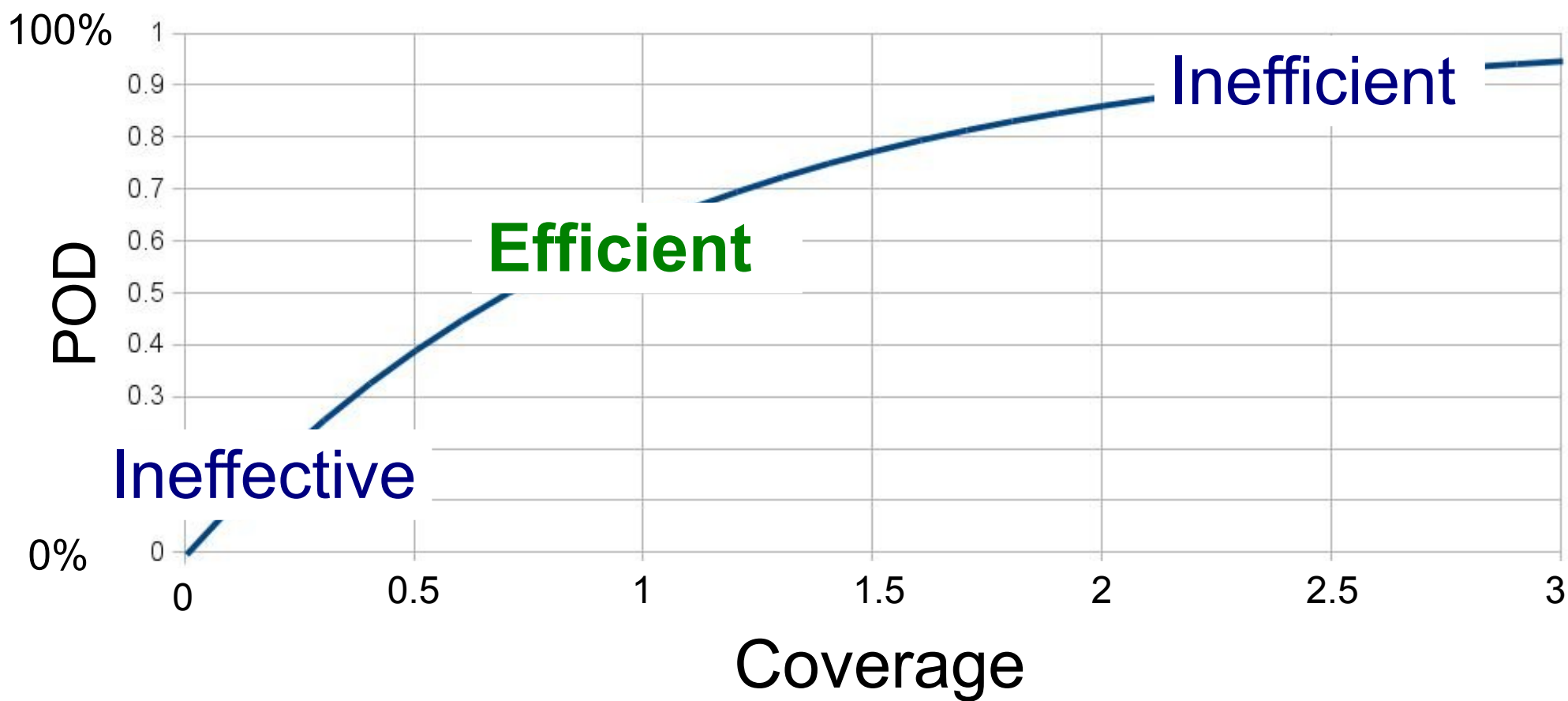
- Parallel Sweeps
- Random Sweeps
- Exponential Detection Function

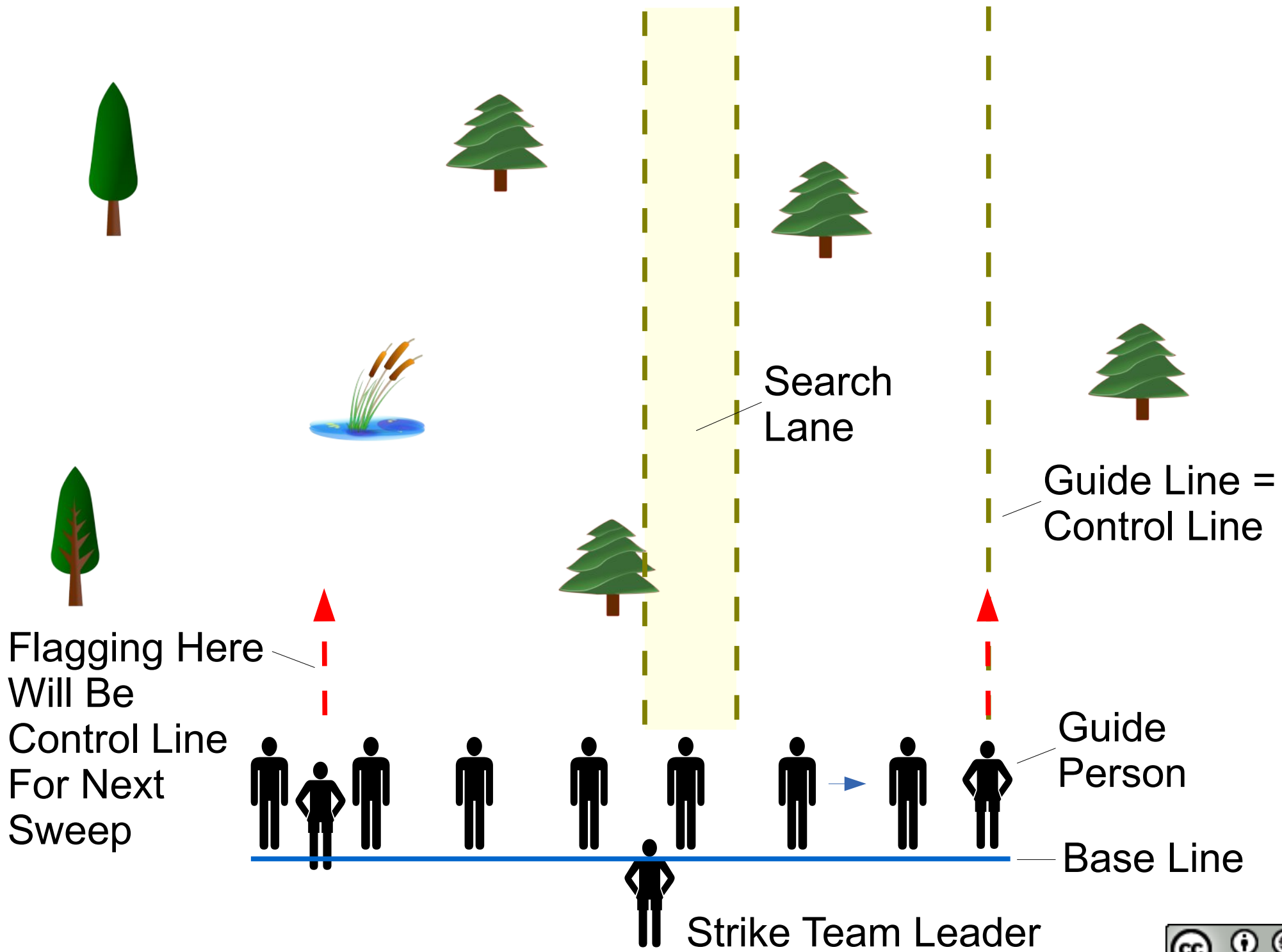


# The Exponential Detection Function



# Coverage and POD

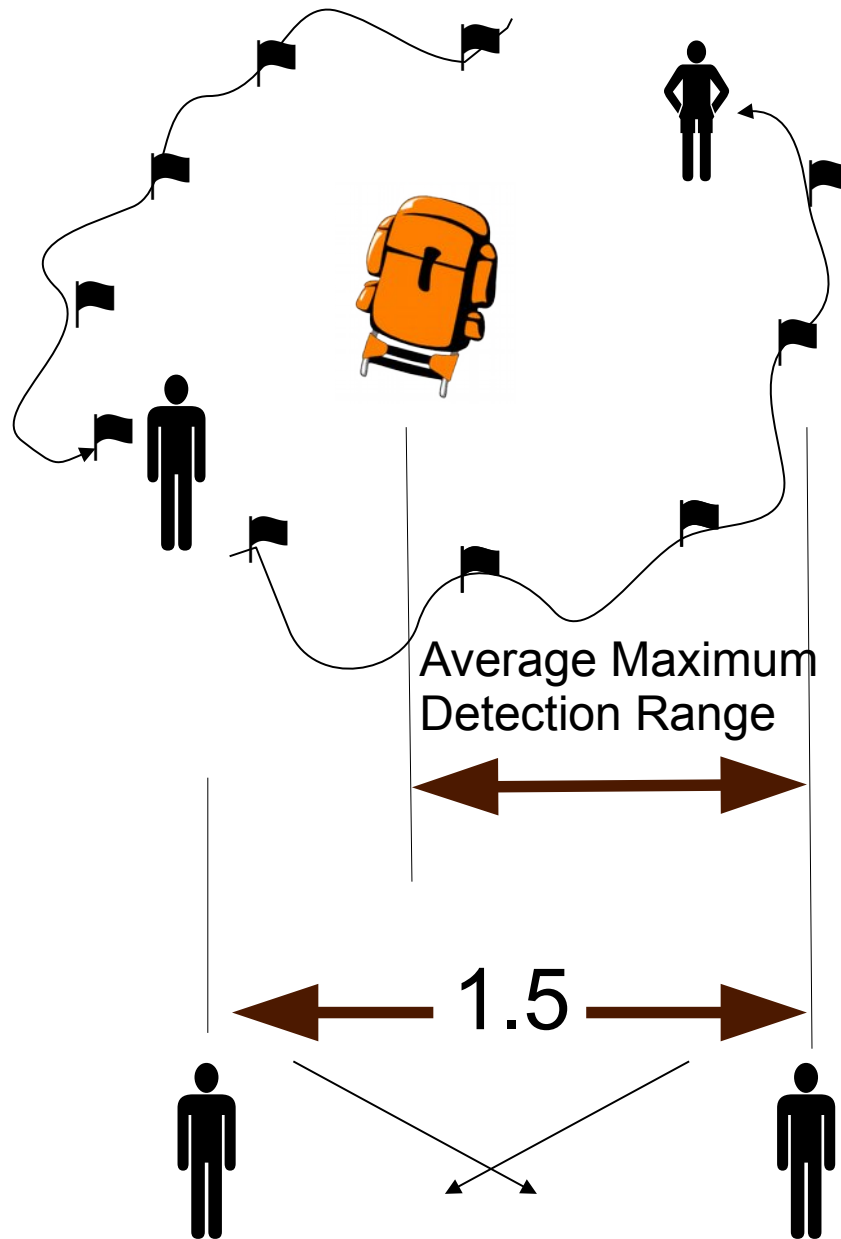






# The Northumbrian Rain Dance

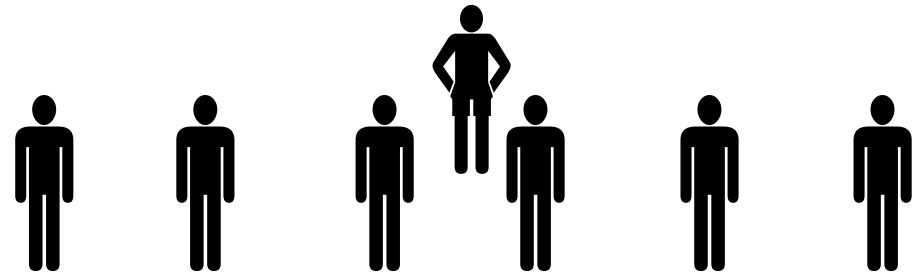
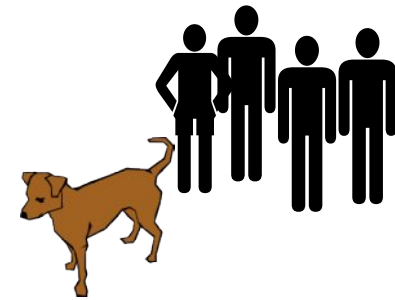
## Estimating Coverage and setting grid spacing



Coverage: 1, POD: 63%

# Functional Roles on an assignment

- Leader
- Navigation
- Communication
- Ground Searcher
- Medical



# Air Scent Canine Task Force

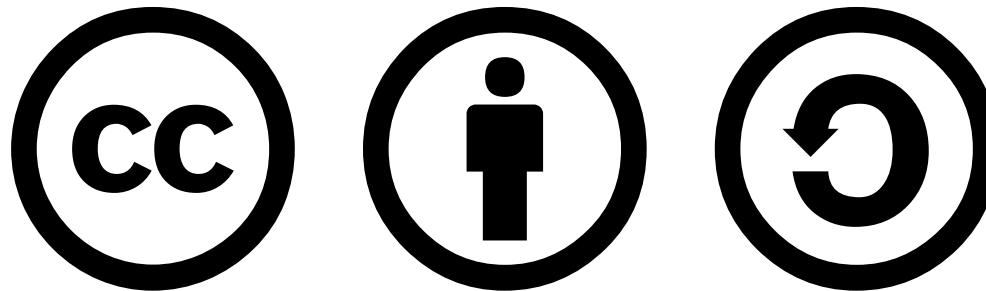
- 1 Air Scent Canine + Handler
- 3 Clue Aware Searchers  
(communications, navigation, medical)





# Individual Responsibilities

- Own Gear
  - Navigation, Flagging, Lights, PPE, Survival
- Dressed appropriately for terrain and weather
- Physically and mentally prepared



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